ASSESSING THE ECONOMIC IMPACTS OF GOVERNMENT R&D PROGRAMS

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Presentation to
Technology Transfer Society
May 20, 1999

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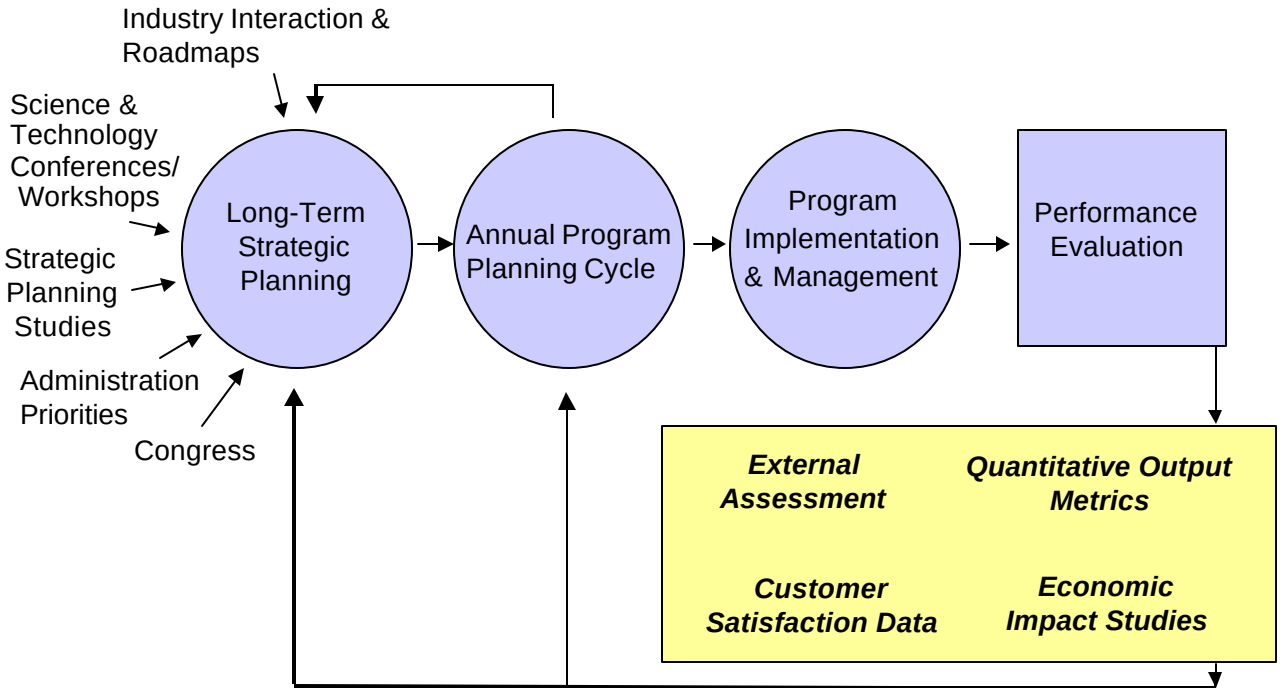
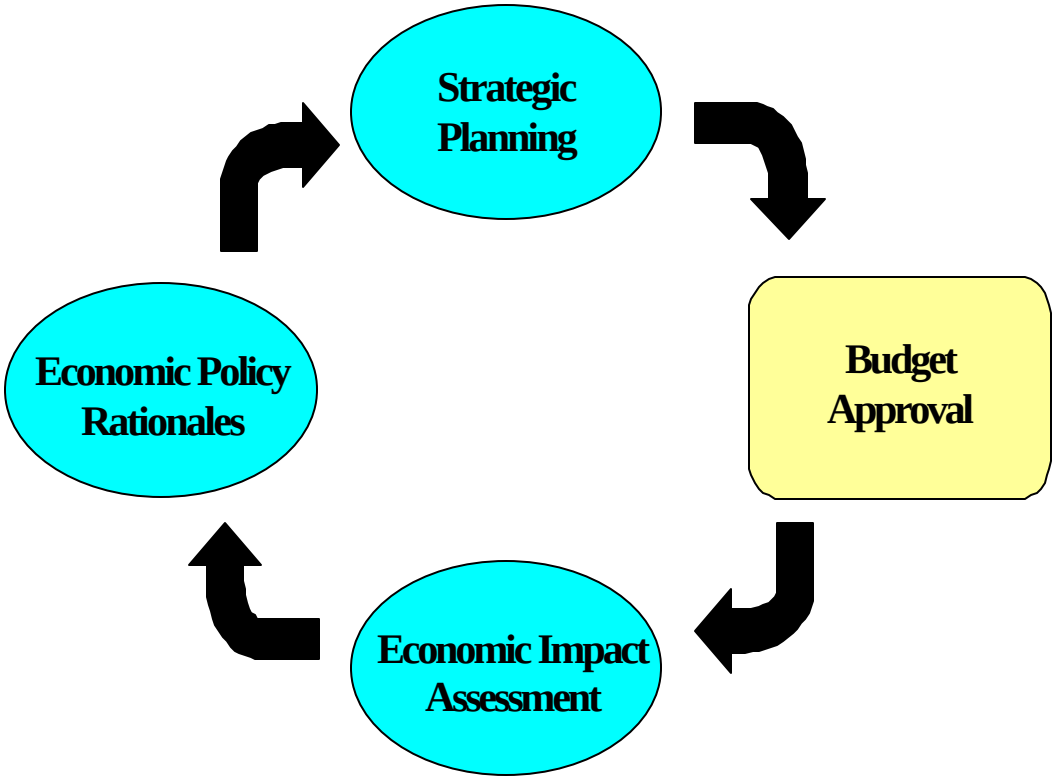
AUDIENCES FOR ECONOMIC IMPACT STUDIES

- External (policy and budget arenas)
- Internal management
- GPRA inputs

Planning and Performance Evaluation at NIST



Uses of Economic Analysis in R&D Policy



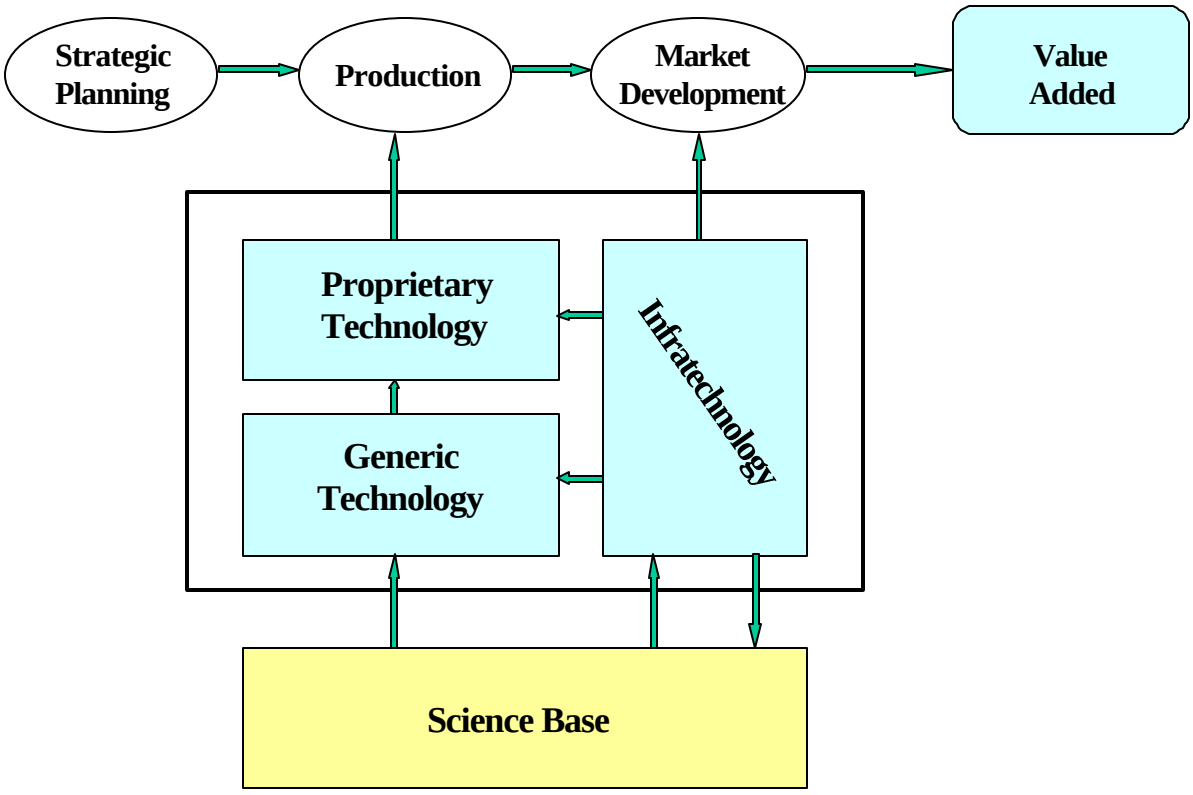
Source: G. Tassey, *Economics of R&D Policy* [1997, p. 20]

NEED FOR IMPACT ASSESSMENT METHODS

"[We have] a clumsy and unsophisticated set of tools for evaluating the best of human innovation and thinking. We also need to be conducting outcomes assessments for our science and engineering activities and we need to collect the data needed to make these assessments."

George Brown (D-CA)
AAAS Symposium, April 29, 1998

Economic Model of a Technology-Based Industry



Source: Tassey [1997, Chap. 4]

ELEMENTS OF R&D ECONOMIC IMPACT STUDIES

- Current industry studies include characterization and analyses of
  - Trends in industry technology and the supporting technology infrastructure
  - Market dynamics and competitive position
  - The technical and economic roles of the technology infrastructure
  - Impact scenarios
  - Impact and cost data
  - Impact characterization and estimation

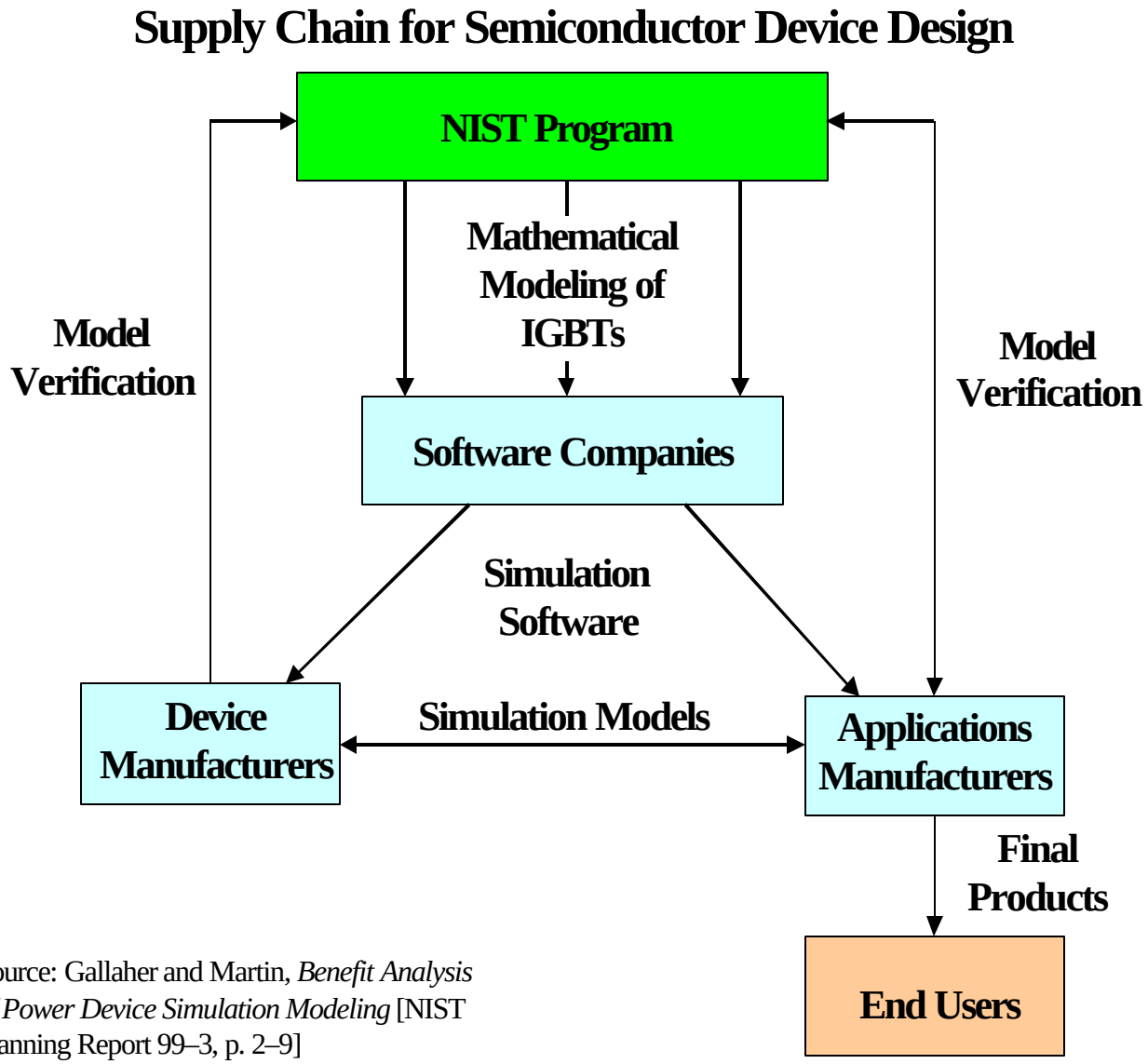
METHODOLOGICAL APPROACH

- Use external consultant *teams* that include
  - technologists
  - industry analysts
  - economists
  - financial analysts
  - survey design specialists
- Apply and adapt conventional techniques of
  - technology assessment
  - microeconomic analysis
  - financial analysis

METHODOLOGICAL APPROACH (cont'd)

- Project team determines
  - Levels in supply chain to analyze
    - identify and characterize nature of impacts
    - estimate data collection feasibility and reliability
  - Hypothesized benefits to estimate
    - quantitatively
    - qualitatively
  - Time period to be covered

EXAMPLE OF SUPPLY CHAIN STUDIED



Source: Gallaher and Martin, *Benefit Analysis of Power Device Simulation Modeling* [NIST Planning Report 99–3, p. 2–9]

IMPACT VARIABLES

- **Output Metrics**
  - contributions to measurement science/new basic standards
  - standard reference materials (SRMs) and associated calibrations
  - standard reference data (SRDs)
  - Use of traceability to NIST standards
  - measurement and test methods
  - quality control algorithms
  - simulation models

IMPACT VARIABLES

- **Outcome Metrics**
  - impacts on industry R&D decisions
  - impacts on market access and hence market entry decisions
  - reduced industry cycle times
  - increased productivity (R&D or process)
  - increased product or service quality
  - increased product and system reliability
  - reduced transaction costs (equity in trade, performance verification)
  - improved interoperability among components of IT-based systems

FORMS OF INFORMATION PRODUCED

- Quantitative estimates
  - net present value
  - benefit-cost ratios
  - social rate of return
- Qualitative assessments and characterizations
- Understanding of impact points in economic process
  - R&D
  - production
  - market development

Software for Semiconductor Design Automation: Economic Sectors and Related Benefit Categories				
Sectors	***R&D Efficiency***	***Transaction Costs***	***Production Costs***	***Product Quality***
Software Companies	X			
Device Manufacturers		**X**		
Applications Manufacturers	**X**	X	X	
End Users				X

Project	*Output*	*Outcomes*	*Measure*
***Chemicals:* alternative refrigerants**	▪ reference data	▪ increase R&D efficiency ▪ increase productivity	SRR: 433% BCR: 4:1
***Communications:* antenna metrology**	▪ theory ▪ translation software ▪ calibrations	▪ increase R&D efficiency ▪ increase productivity ▪ lower transaction costs	SRR: 25% BCR: 4:1
***Semiconductors:* software for design automation**	▪ simulation modeling	▪ increase R&D efficiency ▪ increase productivity ▪ increase product quality ▪ lower transaction costs	SRR: 67–86% BCR: 16:1–31:1

METHODOLOGICAL ISSUES

- Industry Coverage
  - Levels in the relevant supply chain
  - Number of levels accessible
- Attribution
  - Separation of NIST infrastructure contribution from industry's investment and from other infrastructure
- Data Availability/Reliability
  - Quality and quantity of information
  - Event-based vs. counterfactual hypothesis

METHODOLOGICAL ISSUES (cont'd)

- Selection of study period
  - Feasible study period often varies from actual program/project life
  - Some projects are continuing at time of study—require projection
- Data Analysis Issues:
  - Programs studied vary in terms of net benefits patterns
  - Affects *comparison* of performance metrics across studies

Example of Difficulties in Quantifying Economic Benefits — Antenna Metrology

(1) Did not estimate R&D cost *differential* that industry and universities would have incurred during 10–year development period

(2) Assumed that after 10–year lag, near-field technology would be *identical* with actual

(3) *Partial* estimates of technical and calibration services cost reductions

(4) Respondents could not quantify *increased* satellite performance

(5) *Acceleration* of ACTS launch date

SUMMARY

- **Uses**
  - Understanding the types and magnitudes of economic impacts from government R&D
  - Understanding impacts on dynamics of impacted markets and economic growth
  - Information for policy/budget processes
  - In general, better project design and management

SUMMARY (cont'd)

- **Limitations**
  - Data availability varies
  - Data quality varies
  - Performance metrics vary across projects and within individual project life cycles
  - Therefore, ability to make comparisons or rankings across projects is limited